Appl. No.: 09/772,502
Amdt. Dated: 01/06/2004
Off. Act. Dated: 10/06/2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended): A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over two outgoing links, the data payload having a given format and protocol, the system ~~comprising~~ comprising:

a label-switch controller on said optical network;

a route generator coupled to said label-switch controller and configured for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes[[,]];

an adder coupled to said label-switch controller and configured for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given one of the nodes for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header[[,]];

a switching device on said optical network which is configured for being controlled by the label-switching controller;

a detector coupled to said switching device and configured for detecting the multicast information at the given one of the nodes to determine two switch control

signals with reference to the multicast information as the data payload and the header propagate through the optical network[[,]];

an optical splitter configured for splitting the optical signal received by said switching device into two split optical signals[[,]];

a selector coupled to said switching device and configured for selecting two local routes through the given one of the nodes in correspondence to the two switch control signals[[,]];

an optical switch having input ports and output ports wherein one of the split optical signals couples to a first input port and the second of the split optical signals couples to a second input port, and wherein one of the outgoing links couples to a first output port and the second of the outgoing links couples to a second output port[[,]]; and

a switch controller, coupled to the optical switch and responsive to the two switch control signals, configured for switching the optical switch in response to the multicast information to optically couple the first input port with the first output port and the second input port with the second output port[[,]];

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload[[,]];

~~the detector further comprising~~

a measurement device within said detector configured for concurrently measuring the header signals to produce a header selection signal[[,]];

a second selector, coupled to the measurement device, configured for determining the active header signal as conveyed by the highest detectable sub-carrier

frequency under control of the header selection signal to produce the switch control signals[[, and]];

a processor, responsive to the incoming optical signal within said detector and configured for detecting the multicast information and for deleting the header signals and recovering only the data payload[[.]];

~~the system further comprising~~

a header generator, responsive to the selector, and configured for determining a new active header signal conveying the multicast information[[.]]; and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

2. (currently amended): ~~The~~ A system as recited in ~~claim 1~~ claim 1:

wherein the adder includes a generator configured for generating a baseband header composed of a plurality of sub-headers;

wherein each of the sub-headers conveys a subset of the multicast information and each of the sub-headers determines one of the switch control signals.

3. (currently amended): ~~The~~ A system as recited in ~~claim 2~~ claim 2, further comprising:

a local oscillator[[.]]; and

a mixer, responsive to the local oscillator and to the baseband header, configured for mixing the baseband header with the local oscillator to produce a frequency-shifted baseband header.

4. (currently amended): ~~The~~ A system as recited in ~~claim 3~~ claim 3, further comprising a combiner, responsive to the mixer, configured for combining the data

payload at baseband with the frequency-shifted baseband header to produce a composite baseband signal.

5. (currently amended): ~~The~~ A system as recited in ~~claim 4~~ claim 4, further ~~including~~ comprising:

a laser source[[,]]; and

an optical modulator, responsive to the laser source and to the combiner, configured for optically modulating the composite baseband signal with the laser source to produce the optical signal.

6. (currently amended): ~~The~~ A system as recited in ~~claim 1~~ claim 1, further ~~including~~ comprising an opto-electrical converter configured for opto-electrically converting the optical signal to an electrical header conveying the active header signal.

7. (currently amended): ~~The~~ A system as recited in ~~claim 6~~ claim 6, wherein the processor includes a demodulator configured for demodulating the electrical header to obtain a demodulated active header signal.

8. (currently amended): ~~The~~ A system as recited in ~~claim 7~~ claim 7, wherein the processor further ~~includes~~ comprises a demodulator configured for detecting the multicast information in the demodulated active header signal.

9. (currently amended): ~~The~~ A system as recited in ~~claim 8~~ claim 8, wherein the processor further ~~includes~~ comprises a reader configured for reading the header information to produce the switch control signals.

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10. (currently amended): ~~The~~ A system as recited in ~~claim 9~~ claim 9, wherein the reader includes means for inputting the multicast information to a content-addressable memory to produce the switch control signals.

11. (currently amended): ~~The~~ A system as recited in ~~claim 1~~ claim 1, further ~~including~~ comprising:

means for opto-electrically converting the optical signal to an electrical header[[,]]; and

wherein the measurement device includes a down-converter configured for down-converting the electrical header to a plurality of intermediate frequency signals indicative of the header signals.

12. (currently amended): ~~The~~ A system as recited in ~~claim 11~~ claim 11, wherein the down-converter ~~includes~~ comprises:

means for locally generating the plurality of sub-carrier frequencies[[,]]; and

a multiplier configured for multiplying the electrical header by the plurality of local sub-carrier frequencies to produce the plurality of intermediate frequency signals.

13. (currently amended): ~~The~~ A system as recited in ~~claim 12~~ claim 12, further ~~including~~ comprising means for envelope detecting each of the intermediate frequency signals to concurrently produce a plurality of envelope-detected signals.

14. (currently amended): ~~The~~ A system as recited in ~~claim 13~~ claim 13, further ~~including~~ comprising means for concurrently threshold detecting each of the envelope-detected signals to produce a plurality of decision signals.

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15. (currently amended): ~~The~~ A system as recited in ~~claim 14~~ claim 14, further ~~including~~ comprising means for inputting the plurality of decision signals to a logic circuit to produce the header selection signal.

16. (currently amended): ~~The~~ A system as recited in ~~claim 1~~ claim 1:

wherein adder includes a generator for generating a baseband header composed of two sub-headers;

wherein each of the sub-headers conveys a subset of the multicast information and each of the sub-headers determines one of the switch control signals.

17. (currently amended): ~~The~~ A system as recited in ~~claim 16~~ claim 16, further ~~including~~ comprising:

a local oscillator[[,]]; and

a mixer configured for mixing the baseband header with the local oscillator to produce a frequency-shifted baseband signal.

18. (currently amended): ~~The~~ A system as recited in ~~claim 17~~ claim 17, further ~~including~~ comprising a combiner configured for combining the data payload at baseband with the frequency-shifted baseband signal to produce a baseband optical signal.

19. (currently amended): ~~The~~ A system as recited in ~~claim 18~~ claim 18, further ~~including~~ comprising:

a laser source[[,]]; and

an optical modulator configured for optically modulating the baseband optical signal with the laser source to produce the optical signal.

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20. (currently amended): ~~The~~ A system as recited in ~~claim 19~~ claim 19:

wherein the header is conveyed by a distinct sub-carrier frequency occupying a frequency band above the data payload[[, and]]

wherein the detector includes,

means for detecting the sub-headers to obtain the multicast information, and

means for processing the multicast information to obtain the two switch control signals for routing the optical signal.

21. (currently amended): A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over a plurality of outgoing links, the data payload having a given format and protocol, the system ~~comprising~~ comprising:

a label-switch controller on said optical network;

a route generator coupled to said label-switch controller and configured for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes[[,]];

an adder coupled to said label-switch controller and configured for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header[[,]];

a switching device on said optical network which is configured for being controlled by the label-switching controller;

a detector coupled to said switching device and configured for detecting the multicast information at the given one of the nodes to determine switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network[[,]];

an optical splitter configured for splitting the optical signal received by said switching device into a plurality of split optical signals[[,]];

a selector coupled to said switching device and configured for selecting a plurality of local routes through the given one of the nodes in correspondence to the switch control signals[[,]];

an optical switch having input ports and output ports wherein each of the split optical signals couples to separate input ports, and wherein each of the outgoing links couples to corresponding output ports[[,]]; and

a switch controller, coupled to the optical switch and responsive to the switch control signals, configured for switching the optical switch in response to the multicast information to optically couple the separate input ports with the corresponding output ports[[,]];

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload[[,]];

~~the detector further comprising~~

a measurement device within said detector configured for concurrently measuring the header signals to produce a header selection signal[[,]];

a second selector, coupled to the measurement device, configured for determining the active header signal as conveyed by the highest detectable sub-carrier

frequency under control of the header selection signal to produce the switch control signals[[, and]]

a processor, responsive to the incoming optical signal, within said detector configured for detecting the multicast information and for deleting the header signals and recovering only the data payload[[,]];

~~the system further comprising~~

a header generator, responsive to the selector, configured for determining a new active header signal conveying the multicast information[[,]]; and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

22. (currently amended): A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over a plurality of outgoing links, the data payload having a given format and protocol, the system ~~comprising~~ comprising:

a label-switch controller on said optical network;

a route generator coupled to said label-switch controller and configured for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes[[,]];

an adder coupled to said label-switch controller and configured for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header[[,]];

a switching device on said optical network which is configured for being controlled by the label-switching controller;

a detector coupled to said switching device and configured for detecting the multicast information at the nodes to determine switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network[[,]];

an optical splitter configured for splitting the optical signal received by said switching device into a number of split optical signals corresponding to number of outgoing links[[,]];

an optical switch having input ports and output ports wherein each of the split optical signals couples to a corresponding one of the input ports[[,]];

an optical combiner coupled to predetermined ones of the output ports[[,]];

a plurality of multiplexers configured for coupling the optical combiner with the outgoing links[[, and]];

a switch controller, coupled to the optical switch and responsive to the switch control signals, and configured for switching the optical switch in response to the multicast information to optically couple the corresponding input ports with corresponding output ports[[,]];

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload[[,]];

~~the detector further comprising~~

a measurement device within said detector configured for concurrently measuring the header signals to produce a header selection signal[[,]];

a second selector, coupled to the measurement device, and configured for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals[[, and]];

a processor, responsive to the incoming optical signal, within said detector configured for detecting the multicast information and for deleting the header signals and recovering only the data payload[[,]];

~~the system further comprising~~

a header generator, responsive to the selector, and configured for determining a new active header signal conveying the multicast information[[,]]; and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

23. (currently amended): A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over two outgoing links, the data payload having a given format and protocol, the system ~~comprising~~ comprising:

a label-switch controller on said optical network;

a route generator coupled to said label-switch controller and configured for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes[[,]];

an adder coupled to said label-switch controller and configured for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header,

the format and protocol of the data payload being independent of the format and protocol of the header[[,]];

a switching device on said optical network which is configured for being controlled by the label-switching controller;

a detector coupled to said switching device and configured for detecting the multicast information at the nodes to determine two switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network[[,]];

a one-by-two optical splitter configured for splitting the incoming optical signal received by said switching device into two split optical signals[[,]];

a four-by-four optical switch having four input ports and four output ports wherein the two split optical signals couple to the first and second input ports[[,]];

a first two-by-one optical combiner coupled to the first and second output ports[[,]];

a second two-by-one optical combiner coupled to the third and fourth output ports[[,]];

a first multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the first multiplexer is coupled to one of the two outgoing links[[,]];

a second multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the second multiplexer is coupled to the other of the two outgoing links[[, and]];

a switch controller, coupled to the optical switch and responsive to the switch control signals, and configured for switching the optical switch in response to the multicast information to couple the first input port with the first output port and the second input port with the third output port[[,]];

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload[[,]];

~~the detector further comprising~~

a measurement device within said detector configured for concurrently measuring the header signals to produce a header selection signal[[,]];

a second selector, coupled to the measurement device, and configured for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals[[, and]];

a processor, responsive to the incoming optical signal, within said detector configured for detecting the multicast information and for deleting the header signals and recovering only the data payload[[,]];

~~the system further comprising~~

a header generator, responsive to the selector, configured for determining a new active header signal conveying the multicast information[[,]]; and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

24. (currently amended): ~~The optical~~ A system as recited in ~~claim 23~~ claim 23, for multicasting a second incoming optical signal to the two outgoing links, the second input optical signal including a second header for conveying second multicasting information, the system further ~~comprising~~ comprising:

a second one-by-two optical splitter configured for splitting the second incoming optical signal received by said switching device into two split second optical signals[[,]];

wherein the second two-by-one optical combiner is coupled to the third and fourth output ports of the optical switch[[, and]];

wherein said switch controller, being responsive to the second header, switches the optical switch in response to the second multicast information to couple the third input port with the second output port and the fourth input port with the fourth output port.

25. (currently amended): A system for multicasting two data payloads through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over two outgoing links, each data payload having a given format and protocol, the system ~~comprising~~ comprising:

a label-switch controller on said optical network;

a route generator coupled to said label-switch controller and configured for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes[[,]];

an adder coupled to said label-switch controller and configured for adding a header to each data payload and embedded in the same wavelength as each corresponding data payload prior to inputting each data payload at an input one of the nodes to produce two optical signals, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for each data payload and each corresponding header, the format and protocol of each data payload being independent of the format and protocol of each corresponding header[[,]];

a switching device on said optical network which is configured for being controlled by the label-switching controller;

a first demultiplexer coupled to said switching device and configured for detecting the first optical signal[[,]];

a second demultiplexer coupled to said switching device and configured for detecting the second optical signal[[,]];

a first one-by-two optical splitter, coupled to the first demultiplexer, and configured for splitting the first optical signal into two split first optical signals[[,]];

a second one-by-two optical splitter, coupled to the second demultiplexer, configured for splitting the second optical signal into two split second optical signals[[,]];

a detector coupled to said switching device and configured for detecting the multicast information at the nodes to determine four switch control signals with reference to the multicast information as each of the data payloads and the corresponding headers propagate through the optical network[[,]];

a first four-by-four optical switch having four input ports and four output ports wherein the first split optical signals couple to the first and second input ports[[,]];

a second four-by-four optical switch having four input ports and four output ports wherein the second split optical signals couple to the first and second input ports[[,]];

a first two-by-one optical combiner coupled to the first and second output ports of the first optical switch[[,]];

a second two-by-one optical combiner coupled to the third and fourth output ports of the first optical switch[[,]];

a third two-by-one optical combiner coupled to the first and second output ports of the second optical switch[[,]];

a fourth two-by-one optical combiner coupled to the third and fourth output ports of the second optical switch[[,]];

a first multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the first multiplexer is coupled to one of the two outgoing links[[,]];

a second multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the second multiplexer is coupled to the other of the two outgoing links[[, and]];

a switch controller, coupled to the first optical switch and the second optical switch and responsive to the switch control signals, and configured for switching the first optical switch and second optical switch in response to the multicast information to couple the first input port with the first output port of the first optical switch, the second input port with the third output port of the first optical switch, the first input port with the first output port of the second optical switch, and the second input port with the third output port of the second optical switch[[.]];

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload[[.]];

~~the detector further comprising for each of the optical signals,~~

a measurement device within said detector which is configured for each of the optical signals, said measurement device configured for concurrently measuring the header signals to produce a header selection signal[[.]];

a second selector, coupled to the measurement device, configured for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals[[, and]];

a processor, responsive to the incoming optical signal, within said detector configured for detecting the multicast information and for deleting the header signals and recovering only the data payload[[.]];

~~the system further comprising~~

a header generator, responsive to the selector, configured for determining a new active header signal conveying the multicast information[[,]]; and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals in each of the optical signals.